

Electricity and Magnetism, Sweden, SP (Swedish National Testing and Research Institute)

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
DC voltage sources: single values	Voltage standard	Difference measurement	1	1	V			0.2	µV/V	2	95%	Yes			1
DC voltage sources: single values	Voltage standard	Difference measurement	1.018	1.018	V			0.2	µV/V	2	95%	Yes			2
DC voltage sources: single values	Voltage standard	Difference measurement	10	10	V			0.2	µV/V	2	95%	Yes			3
DC voltage sources: low values	DC voltage source: voltage U	Direct comparison	0.001	10	V	Pressure	1000 hPa	$Q[20E-09, U_o/U], U_o = 5 \text{ nV}, U \text{ in V}$	V/V	2	95%	Yes			4
DC voltage sources: intermediate values	DC voltage source, multifunction calibrator	Resistive divider	10	1000	V			0.8 to 1.0	µV/V	2	95%	Yes			5
DC voltage meters: very low values	Nanovoltmeter, microvoltmeter	Direct comparison	1E-07	1E-03	V			20	nV	2	95%	No			5.1
DC voltage meters: intermediate values	Nanovoltmeter, microvoltmeter: voltage U	Direct comparison	0.001	0.1	V			$Q[2E-06 + U_o/U], U_o = 20 \text{ nV}, U \text{ in V}$	V/V	2	95%	Yes			5.2
DC voltage meters: intermediate values	DC voltmeter: voltage U	Direct comparison	0.001	10	V			$Q[0.1E-06 + U_o/U], U_o = 5 \text{ nV}, U \text{ in V}$	V/V	2	95%	Yes			6
DC voltage meters: intermediate values	DC voltmeter	Direct comparison	10	1000	V			1.5 to 4	µV/V	2	95%	Yes			7
DC voltage ratios: up to 1100 V	Resistive dividers	Comparison of individual resistors in the divider	0.01	1		Input voltage	10 V to 1000 V	$5E-07 \text{ to } 2E-07$		2	95%	Yes			9

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DC voltage ratios: up to 1100 V	Kelvin Varley divider	Comparison with reference divider	1E-06	1		Input voltage	1 V to 100 V	2E-07		2	95%	No			9a
DC resistance standards and sources: low values	Fixed resistor	DCC bridge	0.01	0.1	mΩ	Power	10 mW	20	μΩ/Ω	2	95%	Yes			10
DC resistance standards and sources: low values	Fixed resistor	DCC bridge	0.1	1	mΩ	Power	10 mW	7	μΩ/Ω	2	95%	Yes			11
DC resistance standards and sources: low values	Fixed resistor	DCC bridge	1	10	mΩ	Power	10 mW	4	μΩ/Ω	2	95%	Yes			12
DC resistance standards and sources: low values	Fixed resistor	DCC bridge	10	100	mΩ	Power	10 mW	2	μΩ/Ω	2	95%	Yes			13
DC resistance standards and sources: low values	Fixed resistor	DCC bridge	100	1000	mΩ	Power	10 mW	0.5	μΩ/Ω	2	95%	Yes			14
DC resistance standards and sources: intermediate values	Fixed resistor	DCC bridge	1	10000	Ω	Power	10 mW	0.5	μΩ/Ω	2	95%	Yes			15
DC resistance standards and sources: intermediate values	Fixed resistor	High resistance ratio bridge	10	100	kΩ	Voltage	< 10 V	2	μΩ/Ω	2	95%	Yes			16
DC resistance standards and sources: intermediate values	Fixed resistor	High resistance ratio bridge	0.1	1	MΩ	Voltage	< 10 V	4	μΩ/Ω	2	95%	Yes			17
DC resistance standards and sources: high values	Fixed resistor	High resistance ratio bridge	1	10	MΩ	Voltage	< 10 V	5	μΩ/Ω	2	95%	Yes			18

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DC resistance standards and sources: high values	Fixed resistor	Modified automatic Wheatstone bridge	10	100	MΩ	Voltage	1 V to 100 V	7	μΩ/Ω	2	95%	Yes			19
DC resistance standards and sources: high values	Fixed resistor	Modified automatic Wheatstone bridge	0.1	1	GΩ	Voltage	1 V to 1000 V	15	μΩ/Ω	2	95%	Yes			20
DC resistance standards and sources: high values	Fixed resistor	Modified automatic Wheatstone bridge	1	10	GΩ	Voltage	1 V to 1000 V	50	μΩ/Ω	2	95%	Yes			21
DC resistance standards and sources: high values	Fixed resistor	Modified automatic Wheatstone bridge	10	100	GΩ	Voltage	10 V to 1000 V	100	μΩ/Ω	2	95%	Yes			22
DC resistance standards and sources: high values	Fixed resistor	Modified automatic Wheatstone bridge	0.1	1	TΩ	Voltage	50 V to 1000 V	300	μΩ/Ω	2	95%	Yes			23
DC resistance standards and sources: high values	Fixed resistor	Modified automatic Wheatstone bridge	1	10	TΩ	Voltage	100 V to 1000 V	500	μΩ/Ω	2	95%	Yes			24
DC resistance standards and sources: high values	Fixed resistor	Modified automatic Wheatstone bridge	10	100	TΩ	Voltage	100 V to 1000 V	1000	μΩ/Ω	2	95%	Yes			25
DC resistance standards and sources: standards for high currents	DC shunt	Voltage drop across resistor	0.01	10	mΩ	Current	<= 600 A	0.05	mΩ/Ω	2	95%	Yes			26
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Comparison	1	1.9	Ω			9	μΩ/Ω	2	95%	Yes			26d
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Comparison	0.01	19	kΩ			4	μΩ/Ω	2	95%	Yes			26e

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DC resistance standards and sources: multiple ranges	Multifunction calibrator	Comparison	100	190	kΩ			5	μΩ/Ω	2	95%	Yes			26f
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Comparison	1	1.9	MΩ			10	μΩ/Ω	2	95%	Yes			26g
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Comparison	10	19	MΩ			12	μΩ/Ω	2	95%	Yes			26h
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Comparison	100	100	MΩ			24	μΩ/Ω	2	95%	Yes			26i
DC current sources: low values	Current generator: current I	Direct measurement	1E-06	1	μA			Q[5E-04, Io/I], Io = 5 fA, I in A	A/A	2	95%	Yes			26a
DC current sources: low values	Multifunction calibrator, current generator: current I	Voltage drop across resistor	1	100	μA			Q[1E-05, Io/I], Io = 0.2 nA, I in A	A/A	2	95%	Yes			26b
DC current sources: intermediate values	Multifunction calibrator, current generator: current	Voltage drop across resistor	100	200	μA			10	μA/A	2	95%	Yes			26c
DC current sources: intermediate values	Multifunction calibrator, current generator	Voltage drop across resistor	0.2	200	mA			7	μA/A	2	95%	Yes			27
DC current sources: intermediate values	Multifunction calibrator, current generator	Voltage drop across resistor	0.2	2	A			9	μA/A	2	95%	Yes			28
DC current sources: intermediate values	Multifunction calibrator, current generator	Voltage drop across resistor	2	20	A			16	μA/A	2	95%	Yes			31

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DC current sources: high values	Current generator	Voltage drop across resistor	20	100	A			30	µA/A	2	95%	Yes			31a
DC current meters: low values	Picoammeter, nanoammeter: current I	Voltage source and resistor	1E-06	1	µA			$Q[1E-04, I_0/I], I_0 = 2 \text{ fA}, I \text{ in A}$	A/A	2	95%	Yes			31b
DC current meters: low values	Nanoammeter, multimeter: current I	Voltage drop across resistor	1	100	µA			$Q[1E-05, I_0/I], I_0 = 0.2 \text{ nA}, I \text{ in A}$	A/A	2	95%	Yes			31c
DC current meters: intermediate values	Nanoammeter, multimeter: current	Voltage drop across resistor	100	200	µA			10	µA/A	2	95%	Yes			31h
DC current meters: intermediate values	Nanoammeter, multimeter	Voltage drop across resistor	0.2	200	mA			7	µA/A	2	95%	Yes			31d
DC current meters: intermediate values	Multimeter	Voltage drop across resistor	0.2	2	A			9	µA/A	2	95%	Yes			31e
DC current meters: intermediate values	Multimeter, current comparator	Voltage drop across resistor	2	20	A			16	µA/A	2	95%	Yes			31f
DC current meters: high values	Current comparator	Voltage drop across resistor	20	100	A			30	µA/A	2	95%	Yes			31g
AC resistance: real component	Fixed resistor	Comparison	1	10	Ω	Frequency	50 Hz to 375 Hz	1.5	µΩ/Ω	2	95%	Yes			32
AC resistance: real component	Fixed resistor	Comparison	10	100	Ω	Frequency	50 Hz to 375 Hz	1.5	µΩ/Ω	2	95%	Yes			33
AC resistance, resistors for high current	AC current shunt	Volt-amperometric	10	100	mΩ	Frequency	50 Hz	1	mΩ/Ω	2	95%	Yes			34
Capacitance: low loss capacitors	Standard capacitor	Transformer bridge	1	1	pF	Frequency	1 kHz	10	µF/F	2	95%	Yes	<i>This CMC is related to the next one</i>		35

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Capacitance: dissipation factor for low loss capacitors	Standard capacitor	Transformer bridge	1E-06	2E-05		Capacitance	1 pF	1E-05		2	95%	No		This CMC is related to the previous one	43
						Frequency	1 kHz								
Capacitance: low loss capacitors	Standard capacitor	Transformer bridge	10	100	pF	Frequency	1 kHz	4	μF/F	2	95%	Yes		This CMC is related to the next one	36
Capacitance: dissipation factor for low loss capacitors	Standard capacitor	Transformer bridge	1E-06	2E-05		Capacitance	10 pF, 100 pF	3E-06		2	95%	No		This CMC is related to the previous one	44
						Frequency	1 kHz								
Capacitance: low loss capacitors	Standard capacitor	Transformer bridge	1	1	nF	Frequency	1 kHz	4	μF/F	2	95%	Yes		This CMC is related to the next one	37
Capacitance: dissipation factor for low loss capacitors	Standard capacitor	Transformer bridge	1E-06	2E-05		Capacitance	1 nF	3E-06		2	95%	No		This CMC is related to the previous one	44.1
						Frequency	1 kHz								
Capacitance: low loss capacitors	Standard capacitor	Transformer bridge	10	10	nF	Frequency	50 Hz, 1 kHz	15	μF/F	2	95%	Yes		This CMC is related to the next one	38
Capacitance: dissipation factor for low loss capacitors	Standard capacitor	Transformer bridge	1E-04	1E-03		Capacitance	10 nF	1.5E-05		2	95%	No		This CMC is related to the previous one	45
						Frequency	50 Hz, 1 kHz								
Capacitance: low loss capacitors	Standard capacitor	Transformer bridge	100	100	nF	Frequency	50 Hz, 1 kHz	25	μF/F	2	95%	Yes		This CMC is related to the next one	39
Capacitance: dissipation factor for low loss capacitors	Standard capacitor	Transformer bridge	1E-04	1E-03		Capacitance	100 nF	2.5E-05		2	95%	No		This CMC is related to the previous one	46
						Frequency	50 Hz, 1 kHz								
Capacitance: low loss capacitors	Standard capacitor	Transformer bridge	1	1	μF	Frequency	1 kHz	50	μF/F	2	95%	Yes		This CMC is related to the next one	40

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Capacitance: dissipation factor for low loss capacitors	Standard capacitor	Transformer bridge	1E-03	0.01		Capacitance	1 µF	5E-05		2	95%	No		This CMC is related to the previous one	47
						Frequency	1 kHz								
Capacitance: low loss capacitors	Standard capacitor	Transformer bridge	10	10	µF	Frequency	1 kHz	200	µF/F	2	95%	Yes		This CMC is related to the next one	41
Capacitance: dissipation factor for low loss capacitors	Standard capacitor	Transformer bridge	1E-03	0.01		Capacitance	10 µF	2E-04		2	95%	No		This CMC is related to the previous one	48
						Frequency	1 kHz								
Capacitance: dissipation factor for low loss capacitors	Standard capacitor	Transformer bridge with guard ring capacitor	1E-06	2E-05		Capacitance	10 pF	2E-06		2	95%	No			42
						Frequency	500 Hz to 1 kHz								
Capacitance, meters	Capacitance bridge, LCR meter	Direct comparison	10	10	pF	Frequency	1 kHz	300	µF/F	2	95%	Yes			50
Capacitance, meters	Capacitance bridge, LCR meter	Direct comparison	0.1	1	nF	Frequency	1 kHz	50	µF/F	2	95%	Yes			51
Capacitance, meters	Capacitance bridge, LCR meter	Direct comparison	10	100	nF	Frequency	1 kHz	100	µF/F	2	95%	Yes			52
Capacitance, meters	Capacitance bridge, LCR meter	Direct comparison	1	1	µF	Frequency	1 kHz	200	µF/F	2	95%	Yes			53
Capacitance, meters	Capacitance bridge, LCR meter	Direct comparison	10	10	µF	Frequency	1 kHz	1.5	mF/F	2	95%	Yes			54
Inductance: self inductance, low values	Standard inductor	Transformer bridge	1	1	µH	Frequency	1 kHz, 4 kHz, 10 kHz	3	mH/H	2	95%	Yes			55
Inductance: self inductance, low values	Standard inductor	Transformer bridge	3	3	µH	Frequency	1 kHz, 4 kHz, 10 kHz	1	mH/H	2	95%	Yes			56
Inductance: self inductance, low values	Standard inductor	Transformer bridge	10	10	µH	Frequency	400 Hz, 1 kHz	0.4	mH/H	2	95%	Yes			57

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Inductance: self inductance, low values	Standard inductor	Transformer bridge	10	10	µH	Frequency	4 kHz	0.42	mH/H	2	95%	Yes			58
Inductance: self inductance, low values	Standard inductor	Transformer bridge	10	10	µH	Frequency	10 kHz	0.5	mH/H	2	95%	Yes			59
Inductance: self inductance, low values	Standard inductor	Transformer bridge	30	30	µH	Frequency	400 Hz, 1 kHz	0.2	mH/H	2	95%	Yes			60
Inductance: self inductance, low values	Standard inductor	Transformer bridge	30	30	µH	Frequency	4 kHz	0.22	mH/H	2	95%	Yes			61
Inductance: self inductance, low values	Standard inductor	Transformer bridge	30	30	µH	Frequency	10 kHz	0.25	mH/H	2	95%	Yes			62
Inductance: self inductance, low values	Standard inductor	Transformer bridge	100	300	µH	Frequency	50 Hz	110	µH/H	2	95%	Yes			63
Inductance: self inductance, low values	Standard inductor	Transformer bridge	100	300	µH	Frequency	400 Hz, 1 kHz	80	µH/H	2	95%	Yes			64
Inductance: self inductance, low values	Standard inductor	Transformer bridge	100	300	µH	Frequency	4 kHz	110	µH/H	2	95%	Yes			65
Inductance: self inductance, low values	Standard inductor	Transformer bridge	100	300	µH	Frequency	10 kHz	160	µH/H	2	95%	Yes			66
Inductance: self inductance, intermediate values	Standard inductor	Resonance bridge	400	1000	mH	Frequency	50 Hz	80	µH/H	2	95%	Yes			67
Inductance: self inductance, intermediate values	Standard inductor	Resonance bridge	400	1000	mH	Frequency	400 Hz	50	µH/H	2	95%	Yes			68
Inductance: self inductance, intermediate values	Standard inductor	Resonance bridge	100	1000	mH	Frequency	1 kHz	50	µH/H	2	95%	Yes			69
Inductance: self inductance, intermediate values	Standard inductor	Resonance bridge	30	100	mH	Frequency	4 kHz	80	µH/H	2	95%	Yes			70

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Inductance: self inductance, intermediate values	Standard inductor	Resonance bridge	10	30	mH	Frequency	10 kHz	140	µH/H	2	95%	Yes			71
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	1	3	mH	Frequency	50 Hz	90	µH/H	2	95%	Yes			72
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	1	3	mH	Frequency	400 Hz, 1 kHz	60	µH/H	2	95%	Yes			73
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	1	3	mH	Frequency	4 kHz	95	µH/H	2	95%	Yes			74
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	1	3	mH	Frequency	10 kHz	150	µH/H	2	95%	Yes			75
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	10	30	mH	Frequency	50 Hz	85	µH/H	2	95%	Yes			76
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	10	30	mH	Frequency	400 Hz, 1 kHz	55	µH/H	2	95%	Yes			77
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	10	30	mH	Frequency	4 kHz	90	µH/H	2	95%	Yes			78
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	10	30	mH	Frequency	10 kHz	170	µH/H	2	95%	Yes			79
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	100	100	mH	Frequency	50 Hz	85	µH/H	2	95%	Yes			80

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Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	100	100	mH	Frequency	400 Hz, 1 kHz	55	µH/H	2	95%	Yes			81
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	100	100	mH	Frequency	4 kHz	95	µH/H	2	95%	Yes			82
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	100	100	mH	Frequency	10 kHz	260	µH/H	2	95%	Yes			83
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	1	1	H	Frequency	400 Hz	55	µH/H	2	95%	Yes			84
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	1	1	H	Frequency	1 kHz	60	µH/H	2	95%	Yes			85
Inductance: self inductance, intermediate values	Standard inductor	Transformer bridge	1	1	H	Frequency	4 kHz	340	µH/H	2	95%	Yes			86
Inductance: self inductance, high values	Standard inductor	Transformer bridge	10	10	H	Frequency	50 Hz	85	µH/H	2	95%	Yes			87
Inductance: self inductance, high values	Standard inductor	Transformer bridge	10	10	H	Frequency	400 Hz	60	µH/H	2	95%	Yes			88
Inductance: self inductance, high values	Standard inductor	Transformer bridge	10	10	H	Frequency	1 kHz	210	µH/H	2	95%	Yes			89
Inductance: meters	LCR meter	Direct comparison	10	10	µH	Frequency	1 kHz	1	mH/H	2	95%	Yes			90
Inductance: meters	LCR meter	Direct comparison	1E-04	1	H	Frequency	1 kHz	0.2	mH/H	2	95%	Yes			91
Inductance: meters	LCR meter	Direct comparison	10	10	H	Frequency	1 kHz	0.5	mH/H	2	95%	Yes			92

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AC voltage: AC-DC transfer difference at low voltages	Thermal converter with amplifier, AC/DC transfer standard, micropotentiometer, resistive voltage divider	Comparison	2	500	mV	Frequency	10 Hz to 1 MHz	9 to 300	µV/V	2	95%	Yes	AC-DC voltage transfer	Calibration can be performed in other measuring points with additional uncertainty contributions	410.1
AC voltage: AC-DC transfer difference at medium voltages	Thermal converter, AC/DC transfer standard	Comparison	0.5	5	V	Frequency	10 Hz to 1 MHz	4 to 75	µV/V	2	95%	Yes	AC-DC voltage transfer	Calibration can be performed in other measuring points with additional uncertainty contributions	410.2
AC voltage: AC-DC transfer difference at higher voltages	Thermal converter with range extender, AC/DC transfer standard	Comparison	5	1000	V	Frequency	10 Hz to 1 MHz	5 to 70	µV/V	2	95%	Yes	AC-DC voltage transfer	Calibration can be performed in other measuring points with additional uncertainty contributions	410.3
AC voltage up to 1000 V, sources	Multifunction calibrator	AC/DC transfer standard	0.002	1000	V	Frequency	10 Hz to 1 MHz	14 to 5000	µV/V	2	95%	Yes	AC voltage source	Calibration can be performed in other measuring points with additional uncertainty contributions	410.4
AC voltage up to 1000 V, meters	AC voltmeter, multimeter, multifunction transfer standard	AC/DC transfer standard	0.002	1000	V	Frequency	10 Hz to 1 MHz	10 to 1000	µV/V	2	95%	Yes	AC voltage meter	Calibration can be performed in other measuring points with additional uncertainty contributions	410.5
AC voltage ratio, real component	Inductive voltage divider	Comparison with reference divider	0.001	1		Frequency	50 Hz	0.5	1E-06	2	95%	Yes		<i>This CMC is related to the next one</i>	411
AC voltage ratio, imaginary component	Inductive voltage divider	Comparison with reference divider	0.001	1		Frequency	50 Hz	0.7	1E-06	2	95%	Yes		<i>This CMC is related to the previous one</i>	414

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AC voltage ratio, real component	Inductive voltage divider	Comparison with reference divider	0.001	1		Frequency	400 Hz, 1000 Hz	0.1	1E-06	2	95%	Yes		This CMC is related to the next one	412
AC voltage ratio, imaginary component	Inductive voltage divider	Comparison with reference divider	0.001	1		Frequency	400 Hz, 1000 Hz	0.3	1E-06	2	95%	Yes		This CMC is related to the previous one	415
AC voltage ratio, real component	Inductive voltage divider	Comparison with reference divider	0.001	1		Frequency	10 kHz	1	1E-06	2	95%	Yes		This CMC is related to the next one	413
AC voltage ratio, imaginary component	Inductive voltage divider	Comparison with reference divider	0.001	1		Frequency	10 kHz	3	1E-06	2	95%	Yes		This CMC is related to the previous one	416
AC voltage ratio, real component	Bridge standard for strain gauge simulation	Comparison with reference divider	0	100	mV/V	Frequency	225 Hz	1.2	µV/V	2	95%	Yes		This CMC is related to the next one	417
AC voltage ratio, imaginary component	Bridge standard for strain gauge simulation	Comparison with reference divider	0	100	mV/V	Frequency	225 Hz	2.3	µV/V	2	95%	Yes		This CMC is related to the previous one	418
AC current: AC-DC transfer difference	Thermal converter with shunt, AC-DC transfer standard with shunt	Comparison	0.0001	20	A	Frequency	10 Hz to 100 kHz	10 to 200	µA/A	2	95%	Yes	AC-DC current transfer	Calibration can be performed in other measuring points with additional uncertainty contributions	488.1
AC current up to 100 A: sources	Multifunction calibrator, transconductance amplifiers	AC-DC transfer standard and shunt	0.0001	20	A	Frequency	10 Hz to 30 kHz	30 to 630	µA/A	2	95%	Yes	AC current source	Calibration can be performed in other measuring points with additional uncertainty contributions	488.2
AC current up to 100 A: meters	AC ammeter, multimeter, multifunction transfer standard	AC-DC transfer standard and shunt	0.0001	10	A	Frequency	10 Hz to 10 kHz	100 to 800	µA/A	2	95%	Yes	AC current meter	Calibration can be performed in other measuring points with additional uncertainty contributions	488.3

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Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
AC power and energy: single phase ($f \leq 400$ Hz), active power	Power converter, power comparator, wattmeter	Comparison with reference standard	0	3000	W	Voltage	30 V to 300 V	40	μW/VA	2	95%	Yes			489
						Current	5 mA to 10 A								
						Power factor	1 to 0, inductive or capacitive								
						Frequency	50 Hz, 60 Hz								
AC power and energy: single phase ($f \leq 400$ Hz), active power	Wattmeter	Comparison with reference standard	0	3000	W	Voltage	30 V to 300 V	600	μW/VA	2	95%	Yes			490
						Current	5 mA to 10 A								
						Power factor	1 to 0, inductive or capacitive								
						Frequency	15 Hz to 400 Hz								
AC power and energy: single phase ($f > 400$ Hz), active power	Wattmeter	Comparison with reference standard	0	3000	W	Voltage	30 V to 300 V	600	μW/VA	2	95%	Yes			490.05
						Current	5 mA to 10 A								
						Power factor	1 to 0, inductive or capacitive								
						Frequency	400 Hz to 20 kHz								
AC power and energy: single phase ($f \leq 400$ Hz), active power	Wattmeter, energymeter	Comparison	0	30	kW	Voltage	30 V to 300 V	80	μW/VA	2	95%	Yes			490.1
						Current	5 mA to 100 A								
						Power factor	1 to 0, inductive or capacitive								
						Frequency	50 Hz, 60 Hz								
AC power and energy: three phase, active power	Wattmeter, energymeter	Comparison	0	90	kW	Voltage	30 V to 300 V	80	μW/VA	2	95%	Yes	Voltage and current ranges are per phase		490.2
						Current	5 mA to 100 A								

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Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
						Power factor	1 to 0, inductive or capacitive								
						Frequency	50 Hz, 60 Hz								
AC power and energy: three phase, active energy	Energy meter	Comparison	0	0.75	kWh	Voltage	30 V to 300 V	80	µWh/V Ah	2	95%	Yes		Voltage and current ranges are per phase, measurand range is for typical time 30 s	490.3
						Current	5 mA to 100 A								
						Power factor	1 to 0, inductive or capacitive								
						Frequency	50 Hz, 60 Hz								
						Measurement time	10 s to 100 s								
AC power and energy: three phase, reactive energy	Energy meter	Comparison	0	0.75	kvarh	Voltage	30 V to 300 V	80	µvarh/V Ah	2	95%	Yes		Voltage and current ranges are per phase, measurand range is for typical time 30 s	490.4
						Current	5 mA to 100 A								
						Power factor	1 to 0, inductive or capacitive								
						Frequency	50 Hz, 60 Hz								
						Measurement time	10 s to 100 s								
High DC voltage: high voltage meters	Kilovoltmeters	Comparison with reference	1	150	kV			15	µV/V	2	95%	Yes			491
High DC voltage: high voltage meters	Kilovoltmeters	Comparison with reference	150	300	kV			1000	µV/V	2	95%	Yes			492
High DC voltage: ratios	DC voltage divider	Comparison with reference divider	1E-06	1		Input voltage	1 kV to 150 kV	15	1E-06	2	95%	Yes			493
						Output voltage	0.1 V to 10 V								
High DC voltage: ratios	DC voltage divider	Comparison with reference divider	1E-06	1		Input voltage	150 kV to 300 kV	0.001		2	95%	Yes			494
						Output voltage	0.1 V to 10 V								

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Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
High voltage impedance: capacitance	High voltage capacitors	Current comparator bridge	0.1	800	nF	Voltage	< 750 V	10	µF/F	2	95%	Yes			495.1
						Frequency	50 Hz to 60 Hz								
						Current	5 µA to 10 A								
High voltage impedance: capacitance	High voltage capacitors	Current comparator bridge	0.8	8	µF	Voltage	< 750 V	20	µF/F	2	95%	Yes			495.2
						Frequency	50 Hz to 60 Hz								
						Current	5 µA to 10 A								
High voltage impedance: capacitance	High voltage capacitors	Current comparator bridge	8	50	µF	Voltage	< 350 V	50	µF/F	2	95%	Yes			495.3
						Frequency	50 Hz to 60 Hz								
						Current	5 µA to 10 A								
High voltage impedance: capacitance dissipation factor	High voltage capacitors: dissipation factor D	Current comparator bridge	0	0.01		Voltage	< 750 V	(1E-05 + 0.005D) to (5E-05 + 0.005D)		2	95%	No			496.1
						Frequency	50 Hz to 60 Hz								
						Current	5 µA to 10 A								
High voltage impedance: capacitance dissipation factor	High voltage capacitors: dissipation factor D	Current comparator bridge	0.01	5		Voltage	< 750 V	0.005D		2	95%	No			496.2
						Frequency	50 Hz to 60 Hz								
						Current	5 µA to 10 A								
High voltage impedance: capacitance	High voltage capacitors	Current comparator bridge	0.01	100	nF	Voltage	0.75 kV to 300 kV	10 to 40	µF/F	2	95%	Yes		This CMC is related to the next one	495
						Frequency	50 Hz								
						Current	5 µA to 10 A								
High voltage impedance: capacitance dissipation factor	High voltage capacitors: dissipation factor D	Current comparator bridge	0	0.01		Voltage	0.75 kV to 300 kV	(1E-05 + 0.005D) to (5E-05 + 0.005D)		2	95%	No		This CMC is related to the previous one	496
						Frequency	50 Hz								
						Current	5 µA to 10 A								

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Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
High voltage impedance: burden: real and imaginary component	Instrument transformer burden: apparent power	Vector meter	1	3800	VA	Frequency	50 Hz	5	mVA/V A	2	95%	Yes			497a
						Voltage	0.1 V to 380 V								
						Current	3 mA to 10 A								
High voltage impedance: burden: real and imaginary component	Instrument transformer burden: power factor	Vector meter	0	1		Frequency	50 Hz	0.01		2	95%	No			497b
						Voltage	0.1 V to 380 V								
						Current	3 mA to 10 A								
AC high voltage: meters	Kilovoltmeter: rms voltage	Comparison with reference	0.7	20	kV	Frequency	50 Hz	0.4	mV/V	2	95%	Yes			498
AC high voltage: meters	Kilovoltmeter: rms voltage	Comparison with reference	20	300	kV	Frequency	50 Hz	0.2	mV/V	2	95%	Yes			499
AC high voltage: peak values	Kilovoltmeter	Comparison with reference	0.7	20	kV	Frequency	50 Hz	0.3	mV/V	2	95%	Yes			500
AC high voltage: peak values	Kilovoltmeter	Comparison with reference	20	300	kV	Frequency	50 Hz	0.2	mV/V	2	95%	Yes			501
AC high voltage: ratio error	AC voltage transformers	Comparison with reference transformer	0	0.02		Frequency	50 Hz	60	1E-06	2	95%	No	This CMC is related to the next one		505
						Voltage ratio	0.1/0.1 kV/kV to (396/1.73)/(0.11/1.73) kV/kV								
AC high voltage: ratio: phase displacement	AC voltage transformers	Comparison with reference transformer	0	20	mrad	Frequency	50 Hz	70	μrad	2	95%	No	This CMC is related to the previous one		506
						Voltage ratio	0.1/0.1 kV/kV to (396/1.73)/(0.11/1.73) kV/kV								
AC high voltage: ratio error	Voltage transformer bridge	Generation of known reference error	0	0.02		Frequency	50 Hz	3 to 30	1E-06	2	95%	No	This CMC is related to the next one		507
						Voltage	5 V to 125 V								
AC high voltage: ratio: phase displacement	Voltage transformer bridge	Generation of known reference error	0	10	mrad	Frequency	50 Hz	7 to 20	μrad	2	95%	No	This CMC is related to the previous one		508

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Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
					Voltage	5 V to 125 V									
Pulsed high voltage and current: lightning impulse voltage parameters	Lightning impulse voltage measuring systems: peak values	Comparison with reference setup	20	200	kV	Standard waveform	1.2/50 (μs)	0.01	V/V	2	95%	Yes			509
Pulsed high voltage and current: lightning impulse time parameters	Lightning impulse voltage measuring systems: front time	Comparison with reference setup	0.84	1.56	μs	Standard waveform	1.2/50 (μs)	0.03	s/s	2	95%	Yes			509.1
					Voltage	20 kV to 200 kV									
Pulsed high voltage and current: lightning impulse time parameters	Lightning impulse voltage measuring systems: time to half value	Comparison with reference setup	40	60	μs	Standard waveform	1.2/50 (μs)	0.03	s/s	2	95%	Yes			509.2
					Voltage	20 kV to 200 kV									
Pulsed high voltage and current: switching impulse voltage parameters	Switching impulse voltage measuring systems: peak values	Comparison with reference setup	20	200	kV	Standard waveform	250/2500 (μs)	0.01	V/V	2	95%	Yes			510
Pulsed high voltage and current: switching impulse time parameters	Switching impulse voltage measuring systems: time to peak	Comparison with reference setup	175	325	μs	Standard waveform	250/2500 (μs)	0.03	s/s	2	95%	Yes			510.1
					Voltage	20 kV to 200 kV									
Pulsed high voltage and current: switching impulse time parameters	Switching impulse voltage measuring systems: time to half value	Comparison with reference setup	2000	3000	μs	Standard waveform	250/2500 (μs)	0.03	s/s	2	95%	Yes			510.2
					Voltage	20 kV to 200 kV									

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Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
Electric discharge: apparent charge	Calibrators for partial discharge measurement: apparent charge q	Comparison with reference setup	1	20	pC			$(0.1 + 0.06q), q \text{ in pC}$	pC	2	95%	No			511
Electric discharge: apparent charge	Calibrators for partial discharge measurement: apparent charge q	Comparison with reference setup	20	$1E+05$	pC			$(1 + 0.018q), q \text{ in pC}$	pC	2	95%	No			512
High AC current: meters	Current measuring systems	Comparison with reference setup	0.1	7.5	kA	Frequency	50 Hz	1	mA/A	2	95%	Yes			514
High AC current: ratio error	Current transformers	Current comparator and AC bridge	0	0.02		Frequency	50 Hz	30	$1E-06$	2	95%	No		This CMC is related to the next one	515
						Current ratio	5/5 A/A to 1200/5 A/A								
High AC current: ratio: phase displacement	Current transformers	Current comparator and AC bridge	0	20	mrad	Frequency	50 Hz	30	μrad	2	95%	No		This CMC is related to the previous one	516
						Current ratio	5/5 A/A to 1200/5 A/A								
High AC current: ratio error	Current transformers	Current comparator and AC bridge	0	0.02		Frequency	50 Hz	60	$1E-06$	2	95%	No		This CMC is related to the next one	517
						Current ratio	1/1 A/A to 7500/5 A/A								
High AC current: ratio: phase displacement	Current transformers	Current comparator and AC bridge	0	20	mrad	Frequency	50 Hz	60	μrad	2	95%	No		This CMC is related to the previous one	518
						Current ratio	1/1 A/A to 7500/5 A/A								
High AC current: ratio error	Current transformer bridge: ratio error e	Generation of known reference error	0	0.02		Frequency	50 Hz	$(3E-06 + 0.012e)$		2	95%	No		This CMC is related to the next one	519
						Current	0.1 A to 10 A								
High AC current: ratio: phase displacement	Current transformer bridge: phase displacement d	Generation of known reference error	-100	100	mrad	Frequency	50 Hz	$(3 + 0.015d), d \text{ in mrad}$	μrad	2	95%	No		This CMC is related to the previous one	520
						Current	0.1 A to 10 A								

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Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
High DC current: meters	Measurement setup	Comparison with reference setup	0.1	3.5	kA			50	µA/A	2	95%	Yes			513
Current and voltage waveform: current harmonics	Main frequency harmonics analysers, flicker meters	Comparison	0.005	10	A	Harmonic number	1 to 50	300 (of fundamental)	µA/A	2	95%	Yes		For IEC 1000-3-3, 1000-3-2. Current in A, dependent on wave shape	495.4
Current and voltage waveform: voltage harmonic distortion	Main frequency harmonics analysers, flicker meters	Comparison	50	300	V	Harmonic number	1 to 50	300 (of fundamental)	µV/V	2	95%	Yes		For IEC 1000-3-3, 1000-3-2. Voltage in V, dependent on wave shape	495.5
Current and voltage waveform: flicker measurements	Main frequency flicker meters: flicker Pst value	Comparison	0.5	10		Voltage	50 V to 300 V	0.05		2	95%	No		For IEC 1000-3-3, 1000-3-2	495.6
Electric fields below 50 kHz: electric field strength	Field strength meter	GTEM-cell	1	15	V/m	Frequency	10 kHz to 50 kHz	0.26		2	95%	Yes			600a
Magnetic fields below 50 kHz: DC magnetic flux density	DC magnetic field meters	NMR, electromagnet	0.03	1	T			0.05	mT/T	2	95%	Yes			521
Magnetic fields below 50 kHz: DC magnetic flux density	DC magnetic field meters	Comparison with reference	0.001	0.03	T			0.01	T/T	2	95%	Yes			522
Magnetic fields below 50 kHz: DC magnetic flux density	DC magnetic field meters	Comparison with reference	0.0001	0.001	T			0.05	T/T	2	95%	Yes			522b
Electromagnetic fields above 50 kHz: electric field strength	Field strength meter	GTEM-cell	1	15	V/m	Frequency	50 kHz to 50 MHz	0.26		2	95%	Yes			600
Electromagnetic fields above 50 kHz: electric field strength	Field strength meter	MicroTEM-cell	1	65	V/m	Frequency	50 MHz to 1 GHz	0.09		2	95%	Yes			601

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Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
Electromagnetic fields above 50 kHz: electric field strength	Field strength meter	In anechoic chamber	1	200	V/m	Frequency	1 GHz to 2 GHz	0.06		2	95%	Yes			602
Electromagnetic fields above 50 kHz: electric field strength	Field strength meter	In anechoic chamber	1	200	V/m	Frequency	2 GHz to 8 GHz	0.07		2	95%	Yes			603
Electromagnetic fields above 50 kHz: electric field strength	Field strength meter	In anechoic chamber	1	200	V/m	Frequency	8 GHz to 13 GHz	0.09		2	95%	Yes			604
Electromagnetic fields above 50 kHz: electric field strength	Field strength meter	In anechoic chamber	1	200	V/m	Frequency	13 GHz to 18 GHz	0.11		2	95%	Yes			605
RF power: absolute power on coaxials	Power meter	Power splitter system	1	1	mW	Frequency	45 MHz to 18 GHz	5 to 10	mW/W	2	95%	Yes			606a
						Power	1 mW								
						Connector	Type N								
RF power: calibration factor on coaxials	Power sensor	Power splitter system	0.7	1.3	W/W	Frequency	45 MHz to 18 GHz	0.5 to 1.0	%	2	95%	Yes			606b
						Power	1 mW								
						Connector	Type N								
Scattering parameters: reflection coefficient (S_{11}) on coaxials, real and imaginary	One-port devices	Vector network analyser	-0.2	0.2		Frequency	45 MHz to 18 GHz	0.006 to 0.015		2.45	95%	No	The expanded uncertainty refers to a complex quantity, therefore $k = 2.45$		606c
						Connector	Type N								
Antenna properties: antenna gain	Linear dipole	Gain transfer method	-27	32	dB	Frequency	300 MHz to 1 GHz	0.5	dB	2	95%	No			606
Antenna properties: antenna gain	Horn antenna	Gain transfer method	-10	20	dB	Frequency	1 GHz to 5 GHz	0.5	dB	2	95%	No			607
Antenna properties: antenna gain	Horn antenna	Gain transfer method	-10	30	dB	Frequency	5 GHz to 8 GHz	0.5	dB	2	95%	No			608

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Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty							
Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
Antenna properties: antenna gain	Horn antenna	Gain transfer method	-10	30	dB	Frequency	8 GHz to 13 GHz	0.8	dB	2	95%	No			609
Antenna properties: antenna gain	Horn antenna	Gain transfer method	-10	30	dB	Frequency	13 GHz to 18 GHz	1.0	dB	2	95%	No			610
RF voltage: RF-DC transfer difference	AC/DC transfer standard	Comparison with reference	0.5	4	V	Frequency	1 MHz to 30 MHz	0.05 to 2	mV/V	2	95%	Yes	RF-DC voltage transfer	Calibration can be performed in other measuring points with additional uncertainty contributions	540.1

Electricity and Magnetism, Sweden, SP (Swedish National Testing and Research Institute)**Uncertainty table: AC-DC voltage transfer**

AC voltage: AC-DC transfer difference at low voltages, SP Internal Identifier: 410.1

AC voltage: AC-DC transfer difference at medium voltages, SP Internal Identifier: 410.2

AC voltage: AC-DC transfer difference at higher voltages, SP Internal Identifier: 410.3

	10 Hz	20 Hz	45 Hz	110 Hz	1 kHz	10 kHz	20 kHz	50 kHz	100 kHz	200 kHz	500 kHz	700 kHz	1 MHz
2 mV	150	150	150	150	150	150	150	150	150	150	170	220	300
5 mV	80	70	70	70	70	70	70	70	70	80	130	180	250
10 mV	50	40	40	40	40	40	40	40	40	50	90	130	200
20 mV	35	25	25	25	25	25	25	25	25	35	70	100	150
50 mV	25	19	15	15	15	15	15	15	17	25	55	75	115
100 mV	18	14	11	11	11	11	11	11	13	21	50	70	100
200 mV	12	9	9	9	9	9	9	9	11	18	45	65	90
600 mV	11	7	6	6	6	6	6	6	8	16	35	50	75
1 V	10	6	5	5	4	5	5	5	7	12	30	45	70
2 V	10	6	5	5	4	5	5	5	7	12	30	45	70
6 V	10	7	6	5	5	6	6	7	10	18	35	50	65
10 V	11	7	6	6	6	6	6	7	11	20	35	50	70
20 V	11	7	6	6	6	6	7	8	12	22	35	55	70
60 V	12	8	7	7	7	8	9	12	18	32	-	-	-
100 V	12	9	8	8	8	9	10	14	23	55	-	-	-
200 V	13	9	9	9	9	9	10	15	25	-	-	-	-
300 V	14	11	11	11	11	11	15	20	40	-	-	-	-
600 V	15	11	11	11	11	12	15	21	40	-	-	-	-
1000 V	16	13	13	13	13	13	15	21	40	-	-	-	-

The expanded uncertainties given in this table are expressed in $\mu\text{V/V}$

Electricity and Magnetism, Sweden, SP (Swedish National Testing and Research Institute)**Uncertainty table: AC voltage source**

AC voltage up to 1000 V, sources, SP Internal Identifier: 410.4

	10 Hz	20 Hz	45 Hz	1 kHz	20 kHz	50 kHz	100 kHz	200 kHz	300 kHz	500 kHz	1 MHz
2 mV	800	750	750	750	750	750	750	1200	1600	2500	5000
10 mV	200	170	170	160	160	160	190	300	420	700	1400
20 mV	160	130	120	120	120	120	150	280	400	650	1300
100 mV	75	35	35	35	35	45	75	150	200	320	700
200 mV	75	30	28	28	28	40	70	140	200	320	700
1 V	35	20	15	14	16	25	50	90	130	220	500
2 V	35	20	15	14	16	25	50	90	130	220	500
10 V	35	22	18	17	19	30	50	90	130	220	500
20 V	35	22	18	17	19	30	50	90	130	220	500
100 V	40	25	20	20	25	40	70	-	-	-	-
200 V	40	25	20	20	25	40	70	-	-	-	-
500 V	40	30	24	24	50	110	-	-	-	-	-
700 V	50	35	30	30	50	110	-	-	-	-	-
1000 V	50	35	30	30	50	-	-	-	-	-	-

The expanded uncertainties given in this table are expressed in $\mu\text{V/V}$

Electricity and Magnetism, Sweden, SP (Swedish National Testing and Research Institute)**Uncertainty table: AC voltage meter**

AC voltage up to 1000 V, meters, SP Internal Identifier: 410.5

	10 Hz	20 Hz	45 Hz	110 Hz	1 kHz	10 kHz	20 kHz	50 kHz	100 kHz	200 kHz	500 kHz	700 kHz	1 MHz
2 mV	550	550	550	550	550	550	550	550	550	600	650	850	1000
5 mV	230	220	220	220	220	220	220	230	230	250	310	400	600
20 mV	60	55	50	50	50	50	50	55	65	100	150	230	350
50 mV	50	40	40	40	40	40	40	40	45	80	110	160	250
100 mV	40	30	27	26	26	26	26	30	35	70	100	150	240
200 mV	35	24	22	21	21	21	21	25	30	65	90	140	230
600 mV	25	15	11	10	10	10	10	14	24	45	70	120	190
1 V	25	15	11	10	10	10	10	11	17	30	60	100	190
2 V	25	15	11	10	10	10	10	11	17	30	60	100	190
6 V	25	15	11	10	10	10	10	11	18	30	60	100	190
10 V	25	15	11	10	10	10	10	11	19	30	60	100	190
20 V	25	15	11	10	10	10	10	11	19	30	60	100	190
60 V	25	17	12	11	11	11	11	14	20	40	-	-	-
100 V	26	17	13	12	12	12	14	18	30	60	-	-	-
200 V	26	17	13	12	12	12	14	18	30	-	-	-	-
600 V	27	19	16	16	16	18	21	28	45	-	-	-	-
1000 V	28	23	22	22	22	22	24	30	50	-	-	-	-

The expanded uncertainties given in this table are expressed in $\mu\text{V/V}$

Electricity and Magnetism, Sweden, SP (Swedish National Testing and Research Institute)**Uncertainty table: AC-DC current transfer**

AC current: AC-DC transfer difference, SP Internal Identifier: 488.1

	10 Hz	20 Hz	45 Hz to 3 kHz	5 kHz	10 kHz	20 kHz	30 kHz	50 kHz	100 kHz
100 µA	60	50	50	50	70	140	200	-	-
200 µA	50	50	50	50	70	140	200	-	-
1 mA	25	20	15	20	25	30	35	45	60
2 mA	25	20	15	20	25	30	35	45	60
5 mA	20	15	15	15	20	25	30	40	50
10 mA	15	10	10	10	10	15	20	30	40
20 mA	20	15	15	15	20	25	30	40	50
30 mA	25	20	15	20	25	30	35	45	60
50 mA	30	20	20	25	30	35	40	-	-
100 mA	30	25	25	25	35	40	50	-	-
200 mA	35	25	25	30	35	40	50	-	-
300 mA	40	30	25	30	35	40	-	-	-
500 mA	40	30	25	30	40	45	-	-	-
1 A	45	35	30	35	40	50	-	-	-
2 A	45	35	30	35	40	50	-	-	-
3 A	50	35	30	35	45	50	-	-	-
5 A	50	35	35	35	45	55	-	-	-
10 A	55	40	40	40	50	60	-	-	-
20 A	60	45	45	45	60	-	-	-	-

The expanded uncertainties given in this table are expressed in µA/A

Electricity and Magnetism, Sweden, SP (Swedish National Testing and Research Institute)**Uncertainty table: AC current source**

AC current up to 100 A: sources, SP Internal Identifier: 488.2

	10 Hz	20 Hz	45 Hz	400 Hz	1 kHz	3 kHz	5 kHz	10 kHz	20 kHz	30 kHz
100 µA	110	100	95	90	90	100	130	230	450	630
200 µA	90	85	80	80	80	90	130	230	450	630
1 mA	60	45	40	40	40	40	55	100	190	260
2 mA	55	40	35	35	35	40	55	100	190	260
10 mA	50	35	30	30	30	30	45	90	170	250
20 mA	50	35	30	30	30	35	50	90	170	250
100 mA	55	40	35	35	35	40	55	90	170	250
200 mA	55	40	35	35	35	40	55	90	170	250
1 A	65	50	40	40	40	45	75	130	240	-
2 A	65	50	45	45	45	50	75	130	240	-
3 A	80	65	50	50	50	60	80	140	250	-
5 A	80	65	55	55	55	65	80	140	250	-
10 A	85	70	60	60	60	70	90	150	250	-
20 A	100	90	80	80	80	90	100	150	-	-

The expanded uncertainties given in this table are expressed in µA/A

Electricity and Magnetism, Sweden, SP (Swedish National Testing and Research Institute)

Uncertainty table: AC current meter

AC current up to 100 A: meters, SP Internal Identifier: 488.3

	10 Hz to 1 kHz	1 kHz to 5 kHz	5 kHz to 10 kHz
100 µA to 1 mA	200	300	600
1 mA to 100 mA	100	200	400
100 mA to 1 A	100	300	600
1 A to 10 A	200	400	800

The expanded uncertainties given in this table are expressed in µA/A

Electricity and Magnetism, Sweden, SP (Swedish National Testing and Research Institute)

Uncertainty table: RF-DC voltage transfer

RF voltage: RF-DC transfer difference, SP Internal Identifier: 540.1

	1 MHz	2 MHz	5 MHz	10 MHz	20 MHz	30 MHz
0.5 V to 1 V	0.11	0.15	0.3	0.7	1.2	2
1 V to 2 V	0.11	0.15	0.3	0.55	0.7	1
2 V to 4 V	0.05	0.07	0.2	0.3	0.4	0.5

The expanded uncertainties given in this table are expressed in mV/V